

INTERNATIONAL SCANNING TOUR ON HIGHWAY GEOMETRIC DESIGN

SUMMARY REPORT

BACKGROUND

The basic premise of a properly designed roadway is the consideration of mobility and safety issues while addressing its natural and human environmental aspects. To achieve such a balance, trade offs among these factors are needed which are routinely performed either consciously or subconsciously. The passage of the Intermodal Surface Transportation Efficiency Act of 1991 emphasized the importance of such highway design. Practices that demonstrate such a design were compiled and documented in a report by the Federal Highway Administration (FHWA) titled "Flexibility in Highway Design." This document emphasized the existing flexibility in design guidelines and encouraged the use of creative design in addressing the site-specific project needs. This philosophy was coined in the U.S. as Context Sensitive Design (CSD) and represents an approach where a balance is sought between safety and mobility needs within the community interests. Both FHWA and the American Association of State Highway and Transportation Officials (AASHTO) recognize the flexibility that exists in the current design guidelines, while acknowledging that the current focus on providing high levels of mobility may conflict with some interests of the community. There is an increasing awareness of these CSD issues within the highway community; research has been initiated to address them by the Transportation Research Board (TRB) and workshops have been developed sponsored by the FHWA, AASHTO, and professional organizations. Moreover, there is a desire among the highway design community to improve the highway design practices and incorporate new elements to enhance established practices and address the community interest elements. The CSD approach is a current practice in several European countries which use these highway geometric design concepts and tools to address mobility, safety and community issues. Therefore, European agencies can offer the U.S. valuable new insights and concepts from their experience in these issues and practices. Such concepts may be transferred or adapted to the U.S. environment to enhance the knowledge base regarding CSD and highway geometric design.

OBJECTIVES AND PANEL COMPOSITION

The objective of this scanning tour was to review and document procedures and practices in highway geometric design and context sensitive design in several European countries. Sweden, Denmark, the Netherlands, the United Kingdom, and Germany were identified as countries which have innovative methods and procedures related to highway geometric design and project development. The goal of the tour was to identify practices in these countries that, when implemented in the United States, would enhance current procedures and promote highway designs that equally address mobility, safety, and community issues.

The Highway Geometric Design International Scanning Tour was jointly sponsored by FHWA and AASHTO and the tour was coordinated by FHWA's Office of International Programs. The delegation included members representing FHWA, AASHTO, state Departments of Transportation (DOTs), the American Public Works Association (APWA), and academia. The delegation members offered expertise in many highway geometric design and project development areas, including context sensitive design practices and procedures, application and use of geometric design principles for enhancing traffic safety and enforcing speed moderation, and consideration and integration of bicyclists and pedestrians in highway design.

GENERAL CONCLUSIONS

The U.S. delegation met with numerous representatives from transportation and highway ministries, research organizations, and consultants who shared many interesting ideas and insights on the scan tour topics. A

summary of the practices the delegation found most significant follows.

Project Planning

The countries visited have an underlying philosophy of a project planning process aiming to improve safety while remaining sensitive to the needs of the community. Their focus is on improving the existing system by making better use of it. A general conclusion from all countries visited was that the project development process is similar to that of the U.S. There are several points where differences were noted. A major difference is that a longer period of time is devoted to the planning process and longer sections, typically entire corridors, are considered. Such an approach provides the opportunity for long range planning by allowing for a more systematic overview and for defining of needs and deficiencies over the entire system. Another difference in the process is the greater emphasis in urban areas on efforts to better integrate projects in communities by addressing the public's concerns for speed management and aesthetics. Integrating both human and natural environmental concerns is an integral part of their project development process.

Of interest to the delegation was also the level and impact of public involvement. The delegation concluded that all five countries involve the public in their project development process, although there were varied degrees and levels of involvement based on the project type and country. Some concepts and methods used to involve the public in the project development were considered to be transferable to the U.S. and could prove beneficial in streamlining the existing practices. Moreover, the involvement of the public at the earliest stage possible was stressed by all governments to avoid potential conflicts and problems when the project has been fully developed.

Some additional observations include the use of safety audits as an evaluation tool for overall project design, the development of project budgets at the end of the process, and the greater role of state and local politics in the project development process. Finally, it was concluded that there is no single approach that can solve all potential problems in project development and a reasonable mix of practices is essential.

Environmental Considerations

The main common concept among all countries is the inclusion of environmental issues as an integral part of the project. It was interesting to find that several countries have copied or adapted the U.S. NEPA process but they have integrated it more efficiently within the project development process. The Dutch believe that recognition of environmental concerns is an every-day practice and that these concerns are addressed sufficiently through their normal design process. Currently, they are considering means by which the regulations and process can be streamlined to reduce project completion time. A general observation was that the highway agencies of these countries are more committed to addressing environmental issues; most of the issues presented were human related, including noise and historical preservation concerns. The reliance on local governmental agencies to develop environmental impact studies (EIS) was also presented as an alternative to identifying problems and possible solutions more easily and at the local level. For ease of project development and faster completion, projects are often restricted to within the existing right of way. The concept of land redistribution was also presented as a method of mitigation: this practice merits further review for application in the U.S. Finally, European Union (EU) laws and directives regarding environmental issues play an important role and they are addressed in their project development process.

Speeds

Even though each country used a different term to describe their "design speed," all use a guiding speed for designing highways that ties the various roadway elements. Sweden, Denmark and the Netherlands have one suggested speed per road category (similar to functional class) while Germany and the United Kingdom have a range of speeds for each category, albeit more narrow than that suggested in the Green Book. A roadway design philosophy common in all countries was the reliance on the physical roadway design to "enforce" operating speeds and the development of a "consistent" or "self-explaining" look for each road category. This is the concept of the "self-explaining, self-enforcing road," which are roads designed for a specific purpose or

function. They address safety in an efficient way for all users by implementing an aesthetic approach to explain the road function and enforce speeds. An interesting observation was the acceptance of lower operating speeds by the road users in these countries compared to the levels of acceptance in the U.S.. This attitude may be reflected in their design approach of a self-enforcing roadway design.

Design Flexibility

All countries utilize design guidelines for roadway design which are considered central to their design philosophy, and all have a design exception process where departures from design guidelines are addressed. This process is more frequently applied to non-motorways (equivalent to non-freeways). The public accepts more easily the lack of flexibility on motorways due to the purpose of these roads. Design flexibility is responsive to site specific limitations; the wider acceptability of such design departures may be due to the fact that each problem area is addressed within its context and constraints. It was also apparent that all these countries have dealt with or are currently dealing with a revision of their design guidelines, which are now more geared to address road purpose and to create a uniform look for each road category. This experience has allowed them to understand the value of design flexibility and exceptions. Set documentation is required to justify departures from the design guidelines, which was very extensive in the United Kingdom. In the countries visited, the guidelines issued by the national highway authorities are usually considered as recommendations for any projects under the authority of local governmental agencies. This provides great flexibility in designing to meet the local needs and conditions

Rural Roads

High speeds on rural roads is also a safety issue for these countries and the focus is on attempts to control and reduce speeds. To achieve this objective, higher speeds are given up to preserve safety. A common treatment on high-volume rural highways is 2+1 facilities, where the middle lane serves as a passing lane in which the right of way alternates, in lieu of 4-lane facilities. Each country has customized this design to conform to their design guidelines and safety goals, including use of varied roadway widths, lengths of passing lanes, median cable guardrail, and end treatment of passing lanes. All agencies indicated that there are capacity gains and safety improvements from use of this design, which may be transferable to the U.S. This practice is similar to the U.S. passing lanes in two-lane roads, but is done for longer roadway sections. Another approach for improving safety on these roads is the use of narrower lane widths, requiring drivers to slow down. This approach is implemented either by physically providing narrower travelways or by visually decreasing the available width by creating wider edge lines or eliminating centerline striping, a concept that was more widely used for low volume, rural roads. To further enforce the narrower roadway concept, clear zones are typically not provided and some roadway objects are shielded by guardrails. It should be pointed out here that these measures are applied to non-motorways where flexibility in design guidelines is present, contrary to motorways where the guidelines are more rigid.

Traffic Calming

All countries are committed to reducing speeds through urban areas and are guided by the concept of integrating all modes and users in the same space. To achieve this objective, several practices have been implemented in urban areas including chicanes, islands, tables, cushions, humps, bumps, gates, landscaping, staggering, bollards, plantings, pavement textures and colors, and optical narrowing (i.e. narrowing the travelway with markings). For a successful implementation, an area wide strategy is required where a systemic rather than a localized solution is sought. This enforces the concept of traffic calming for the entire area providing the driver with a clear and continuous message. Moreover, proper design for the intended travel speed for each component results in a roadway which provides discomfort to drivers exceeding the speed but not to those who travel at the desired speed. Community acceptance is also very important for a successful implementation. Most of these practices are transferable to the U.S. urban environment, although the differences in land use, development, and transportation users between Europe and USA must be recognized.

Roundabouts

Roundabouts are used extensively in all countries (more than 1000 each in four of the five countries) and are considered a very safe form of intersection. Safety studies in most countries indicate large reductions in fatality and injury crashes, although the reduction in the overall number of crashes is sometimes not as large. These empirical data demonstrating the safety improvement from roundabouts can be used in the U.S. to supplement and support the early U.S. experience with roundabouts and to support further usage and implementation of roundabouts. These facilities can also improve intersection capacity over signalization; those with single lane approaches seem to perform very well with volumes of up to 2,500 vehicles per hour due to their simplicity. However, safety gains are typically due to reductions in speeds through the roundabout that may reduce mobility and create delays to through traffic. To increase capacity within the roundabout, some countries are implementing multi-lane approaches and signalization, which may create safety issues. Roundabouts provide the designer with the flexibility to adjust the design to the site specific conditions. An example of this flexibility is the use of tear-drop shaped roundabouts at interchanges in Sweden. The size of the roundabout is also important. It is a flexible design element which also has an impact on the right of way requirements. An issue of concern is the interaction between vehicles and pedestrians and bicycles and how to integrate these users within the roundabout.

Bicyclists and Pedestrians

While all countries visited consider and address the needs of bicyclists and pedestrians, there are two different philosophies regarding their level of consideration. Sweden, Denmark and the Netherlands place a high importance in addressing the needs of these users and provide separate facilities as part of their network. Moreover, there is systematic effort in these countries to promote alternative use of transport modes, and thus cycling and walking are heavily promoted. On the other hand, Germany and the United Kingdom consider these users in their planning process but they give them a lower importance than in the other countries. One reason for this difference may be also the levels of demand which are lower in Germany and the United Kingdom than in the other countries. All five countries place an equal importance on the mobility needs of bicyclists and pedestrians in urban areas and frequently give them higher priority over the mobility needs of vehicles. An issue that all countries are struggling with is the integration of these users into roundabouts. Denmark and the Netherlands provide completely separate paths for these users while the other countries provide paths within the same travelway. Finally, the under-reporting of bicyclists' and pedestrians' crashes is a concern in addressing safety levels and determining the most appropriate path type for these users.

RECOMMENDATIONS AND IMPLEMENTATION STRATEGIES

In the European countries that were visited, the general philosophy for highway design and project development is to develop a transportation program and system that enhances community values and integrates roadways into communities and the environment. This philosophy permeates their project development process, safety improvements, roadway design concepts, geometric design guidelines, and public involvement and environmental commitments. This is the essence of the recent push to promote the CSD approach in the U.S. and a shift toward this philosophy is supported by FHWA and many state DOT's. Moreover, the roadway design philosophy of the Europeans is to develop a roadway that is designed for a specific purpose, implements an aesthetic approach to visually explain this concept, and addresses safety in a way that considers all users. Finally, all countries have very high safety goals (ranging from zero fatalities to reductions of more than 40% in all crashes) which guide their design approach and philosophy. To achieve these goals they are willing to provide roadways that self-enforce speed reductions, potentially increase levels of congestion, and promote alternative modes of transportation. This approach contrasts with the U.S. design philosophy, in which wider roads are deemed safer, there is a heavier reliance on signs to communicate the intended message, and there is a lower tolerance of congestion and speed reduction.

While all practices are not entirely new to all states in the U.S., we may be able learn from their form and the extent of their application in Europe. To this end, the US delegation developed a list of implementation strategies

for enhancing existing project development and highway geometric design practices in the U.S. (Table 1). Further implementation strategies for the U.S. delegation will include electronic and printed distribution of the final report, presentations, and published articles.

Table 1. Summary of findings and recommendations and implementation strategies

Subject	Findings	Recommendations and implementation strategies
Project Planning	The Dutch are using a process of design workshops in which project alternatives are developed simultaneously with public involvement. Based on their experience, this process seems to alleviate conflicts between highway agencies and the public and reduces project planning time.	<ul style="list-style-type: none"> • Investigate the Dutch use of design workshops to determine whether this practice can both enhance the CSD approach and improve and expedite the existing NEPA process. Consider piloting studies, if appropriate. • Encourage states to consider including public involvement in the earliest possible stage of the project planning process.
2+1 Roads	The concept of 2+1 roads has been shown to address simultaneously safety and capacity issues and is considered an applicable concept. This design is similar to the U.S. practice of providing passing lanes in 2-lane roads.	<ul style="list-style-type: none"> • Survey existing practices in the EU and the U.S. and develop a Synthesis Report sponsored by TRB. The Task Force on Geometric design of AASHTO will develop a proposal for TRB.
Geometric Design Philosophy	The concept of self-explaining, self-enforcing road is a common goal for all countries. Such roads are designed for a specific purpose or function. They address safety in an efficient way for all users by implementing an aesthetic approach to explain the road function and enforce speeds.	<ul style="list-style-type: none"> • Increase awareness among practitioners and roadway designers, possibly through an educational effort sponsored by AASHTO, TRB, and APWA.
Roundabouts	Roundabouts are a very safe and efficient means for intersection control; single-lane roundabouts are used widely and successfully in Europe; roundabouts with two approach lanes are widely used in England but are being introduced more cautiously in continental Europe due to concerns about driver confusion and safety; and there are safety concerns regarding interaction of vehicles with bicyclists and pedestrians.	<ul style="list-style-type: none"> • Encourage states to consider initial implementation of roundabouts at areas where success is guaranteed. • Initiate an educational campaign to promote use of roundabouts in the U.S. by developing a workshop and inviting EU experts. Several agencies and professional organizations could sponsor this including FHWA, AASHTO, APWA, ASCE, and ITE. • Form a steering committee to determine what the educational strategy should be. • Increase dissemination of the report "Roundabouts: An information guide," FHWA-RD-00-067.

Traffic Calming	<p>Traffic calming through urban areas reflects a design philosophy for balancing the needs of all user needs by constraining speeds. A systemic approach is essential to successful implementation with a higher reliance on visual clues to deliver the speed reduction concept. Designs should not “punish” those obeying speed restrictions.</p>	<ul style="list-style-type: none"> • Identify and document available literature regarding traffic calming practices, possibly through a Synthesis Report sponsored by APWA, TRB or ITE. • Initiate a professional awareness campaign to promote proper use of traffic calming devices through an APWA information campaign. • Support the development of the APWA informational document on the use of traffic calming devices. • Develop a course or workshop proposal on use of traffic calming devices. This is a possible follow up action item for FHWA and AASHTO.
Context Sensitive Design	<p>The development of transportation projects and systems that enhance community values while integrating roadways into the environment is an every-day practice that all countries follow. They use design exceptions to address this concept and they use aesthetics both for safety enforcement and visual appeal.</p>	<ul style="list-style-type: none"> • Promote the development of a workshop or course that address CSD concepts to be delivered nationwide. • Make short presentations on the CSD philosophy including aesthetics, traffic calming, self-explaining self-enforcing roads, and roundabouts at various meetings of SASHTO, FHWA, ASCE, ITE. • Identify courses offered by the National Highway Institute (NHI) that need to be updated to include CSD concepts. • Promote CSD concepts to impact high level personnel of highway agencies and academia.